New to Science Fair?

- No worries!
- Let's discuss everything you need to know to get started.

Science vs Engineering

Science Process
Define the Problem
Find a purpose
Construct a hypothesis Identify variables
Write a research plan Complete forms
Test hypothesis by conducting experiment(s)
Analyze results
Draw a conclusion(s); ask new question

Engineering Process
Define the Problem
Find a goal
Develop design criteria
Write a research plan Complete forms
Build and test prototype
Analyze results
Draw a conclusion(s); ask new question

What's the difference?

The first key to engaging students in doing real science is to understand the difference between a science demonstration and a hands-on science experiment.

- DEMONSTRATIONS
  - usually performed by the teacher and are typically used to illustrate a science concept.

- SCIENCE EXPERIMENTS
  - give participants the opportunity to pose their own "what if . . .?" questions.

STEP-BY-STEP
What do the students need to do?

1. *Obtain APPROVAL from parents!*
2. *Bring a research journal (composition book)*
3. *Select a topic*
4. *Do background research*
5. *Write a research plan*
6. *Test Hypothesis by conducting science experiments*
7. *Analyze Data and draw conclusions*
8. *Write Abstract and complete forms*
9. *Prepare display board*
10. *Practice*

Keep a Research Journal or Data (Log) Book!

1. A log book is a notebook that must be **bound** with stitching or glue so that the pages are not removable.
2. Your log book should be written in **ink only**. Do not use pencil or printouts from a computer (except graphs and charts).
3. Put your **name** and **school** on the front of your log book.
4. Include **notes** on readings and bibliographic information.
5. Include your thoughts, ideas, and **trials**.

Keep a Research Journal or Data (Log) Book!

6. Include your **raw data** (all of the measurements you collect during your experimental trials)

7. Staple in copies of **graphs** or charts

8. Attach **photos** and label them including **credit** to the photographer

9. **Date** every entry and enter each **science** activity you do.

10. Do **not** try to make your log book neat. It should be readable, but you may cross out information you don't want as you work

11. **Never remove** pages from your log book!!

Selecting a Topic

- Choose a question that you like best out of about 3
- Do I **know a little** about the topic?
- Is it **interesting** to me?
- Is it **feasible**? Can it be answered through experimentation or investigation?
- Will the results be **useful** for something?
- Are equipment and supplies readily **available** and **affordable**?
- Will it involve **measurements**?
- What **variables** will change? (Science & Engineering)
- Can I **design and build** a prototype to test? (Engineering)

Ask a Question

- CLEARLY describe the purpose of the investigation
- Briefly state what it is you want to find out

Do background research

- Collect information to help understand why the experiment turns out the way it does.
- Collect information from at least five sources.
- Resources: Galileo, library, Internet, people
- Keep a bibliography of resources.

- **Key Goal:** Obtain enough information to make a prediction of what will happen in the experiment.

Construct a Hypothesis or set a Goal

SCIENCE

- **What is a hypothesis?**

  Use of prior knowledge (an educated guess) to predict the answer to a question

  If/then: If I do [this], then [this] will happen.

  – *"If I increase the temperature of water in a cup, then the more sugar will dissolve."*

  – *Cause (independent variable)/effect (dependent variable)*

ENGINEERING

- **What is a goal?**
  What you want to accomplish with your project.
- **What are the criteria?**
  Guidelines, standards and requirements you decide on to control the design in a fair and equal way

Write a research plan

- Include the question, hypothesis or goal, methodology, and bibliography
- Teacher, parent or adult sponsor may need to type this for the students.
- Research plan must be approved by your local science fair Safety Review Committee BEFORE experimentation can be performed.
  - *All you need is an educator, administrator and medical professional (school nurse or counselor).*

Follow the rules

DO's	DON'T's
… collect biologically dangerous organisms at home (ex. yeast, bacteria)	…culture them at home; Culturing and other experiments must be done at a lab or at a regulated research site A qualified scientist form must also be completed by a qualified expert who is providing oversight of the project.
…use farm animals in a research project on a farm or ranch. The animals can be used in non-invasive, non-intrusive, non-biomedical studies utilizing standard farming practices that do not negatively affect an animal's health and well-being.	…use invasive, intrusive or biomedical procedures; i.e. all procedures involving entry into a living body by an incision, and/or by insertion of instruments, tubes, probes, etc. Injections for the health of an animal, as directed by a vet, are <u>not</u> considered invasive (e.g., insulin, vitamins).
…conduct research with human subjects . All human subject projects must be reviewed and approved by an Institutional Review Board (IRB) before the research begins.	…conduct any activities unless you get signed permission from participant (if over age 18) or parent/guardian or supervising adult.
…conduct experiments with plants and soils.	…manipulate soils by adding materials such as coca cola, Kool-Aid, etc.
…check with school, regional fair, law enforcement, etc. before beginning research involving hazardous chemicals, activities or devices to ensure proper guidelines (law, use) and supervision, and safety is provided FORM 4	…begin a project before consulting proper authorities : ·hazardous chemicals - ex. DEA-controlled substances, alcohol, prescription drugs , tobacco; ·activities - ex. radiation, lasers; or ·devices - ex. firearms, explosives, Tasers

Test the hypothesis by doing an experiment

Process

Part 1: *Design an experimental procedure*

- Steps and materials should be spelled out

Part 2: *Do an experiment*

- (SCIENCE): when actual testing of the hypothesis occurs you are answering the question

- (ENGINEERING): when actual testing of the prototype design occurs you are answering the question

Do an experiment

Expectations

- *It's ok if the first experiment goes wrong and your child has to modify the procedure*
- *It's ok if the experiment is inconsistent with the hypothesis*
- *Safety, safety, safety!*
- *Repeat your trials many times to collect good data*
- *Validating your method or design is important*
- *It takes time!*

Collect, Organize and Analyze the data

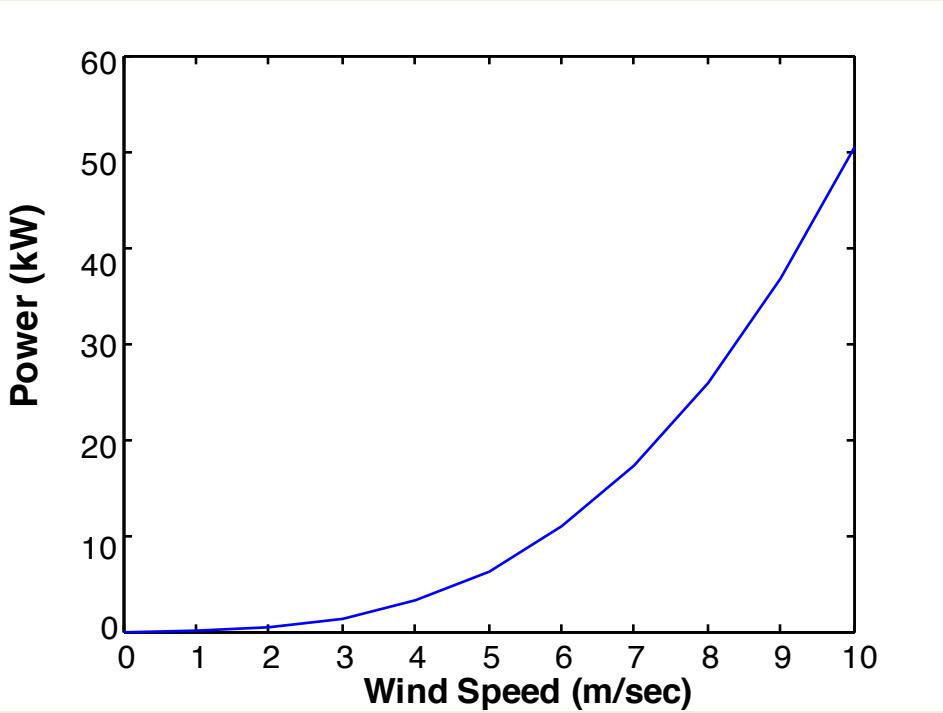
Collected and organized data: Using Tables and Graphs

Table 1. The effect of wind speed on wind generator power

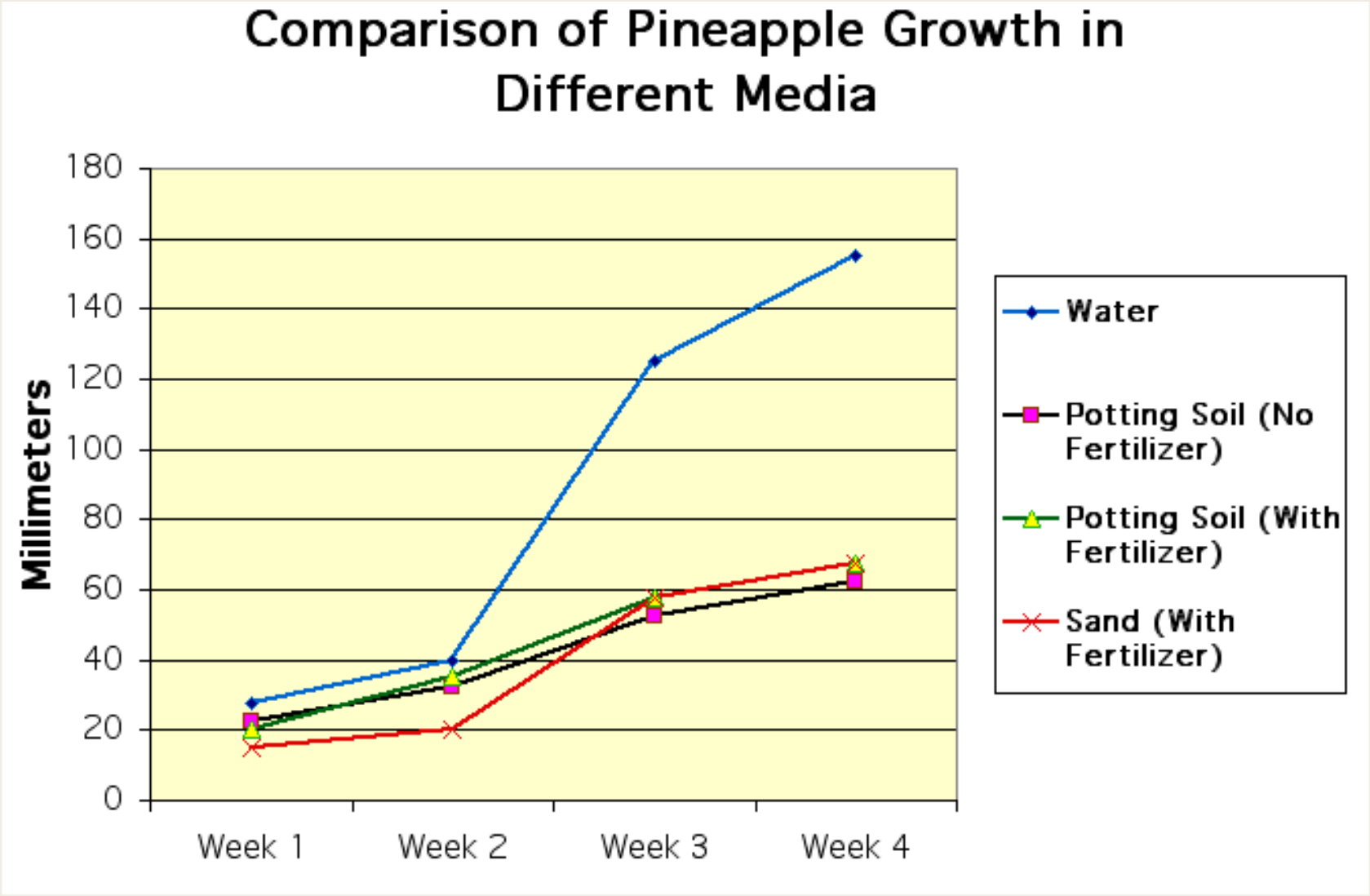
Wind Speed (m/sec)	Power (kW)
0	0.0
1	1.0
2	1.1
3	1.2
4	6.1
5	8.8
6	
	18.5
	27.9
9	37.5
10	50.1

NO NAKED NUMBERS!!!

Figure 1. How wind generator power changes with wind speed



Collect, Organize and Analyze the data



Write an ABSTRACT

A project abstract is a brief paragraph (limited to 250 words or 1,800 characters) highlighting and/or summarizing the major points or most important ideas about the project. An abstract allows judges to quickly determine the nature and scope of a project.

Tips to writing an effective abstract:

- Emphasize these aspects: purpose (hypothesis), methods (procedures used), data summary or analysis, and conclusions.
- Focus only on the current year's research.
- Omit details and discussions.
- Use the past tense when describing what was done. However, where appropriate use active verbs rather than passive verbs.
- Use short sentences, but vary sentence structure.
- Use complete sentences. Don't abbreviate by omitting articles or other small words in order to save space.
- Avoid jargon and use appropriate scientific language.
- Use concise syntax, correct spelling, grammar, and punctuation.

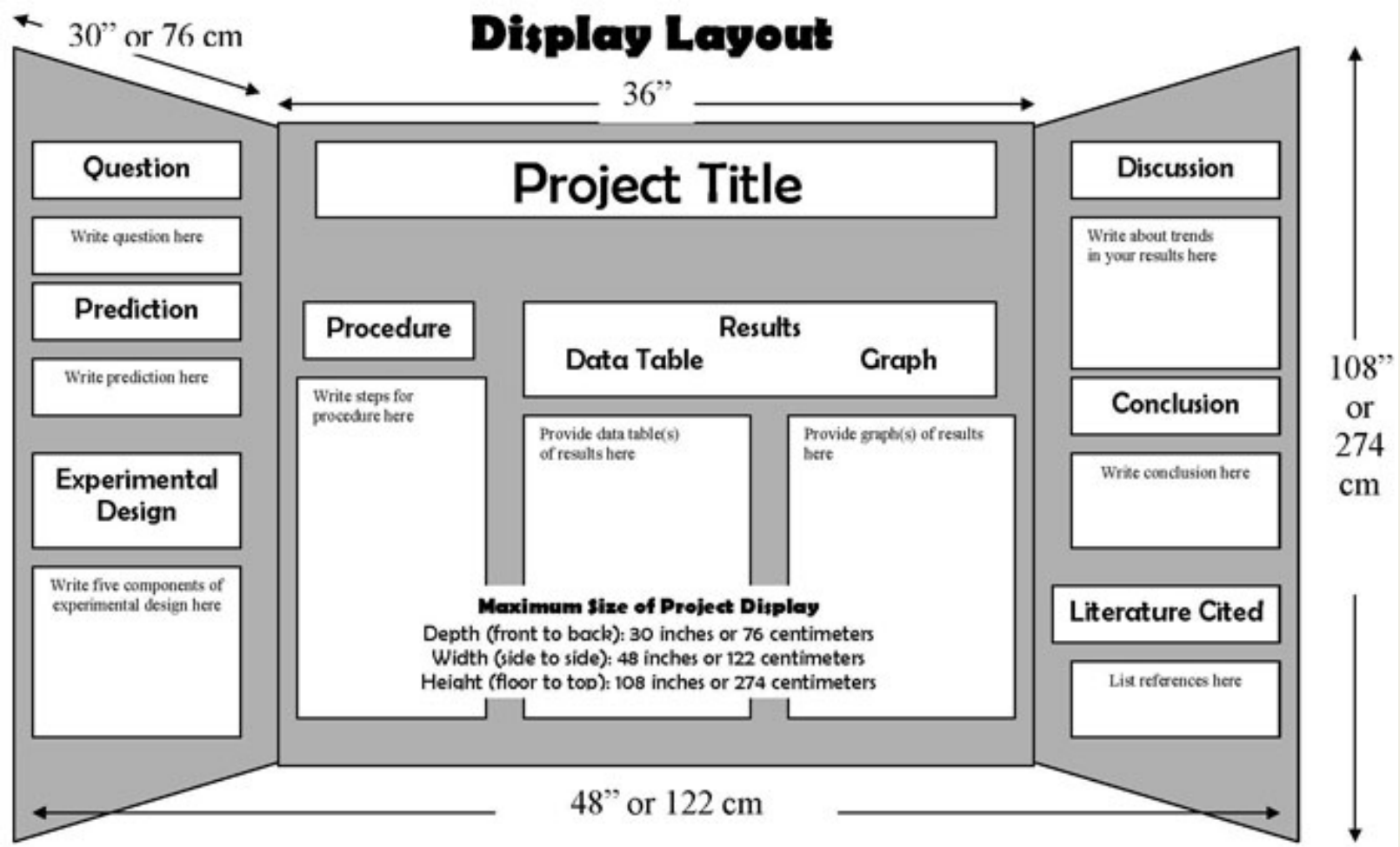
Communicate results

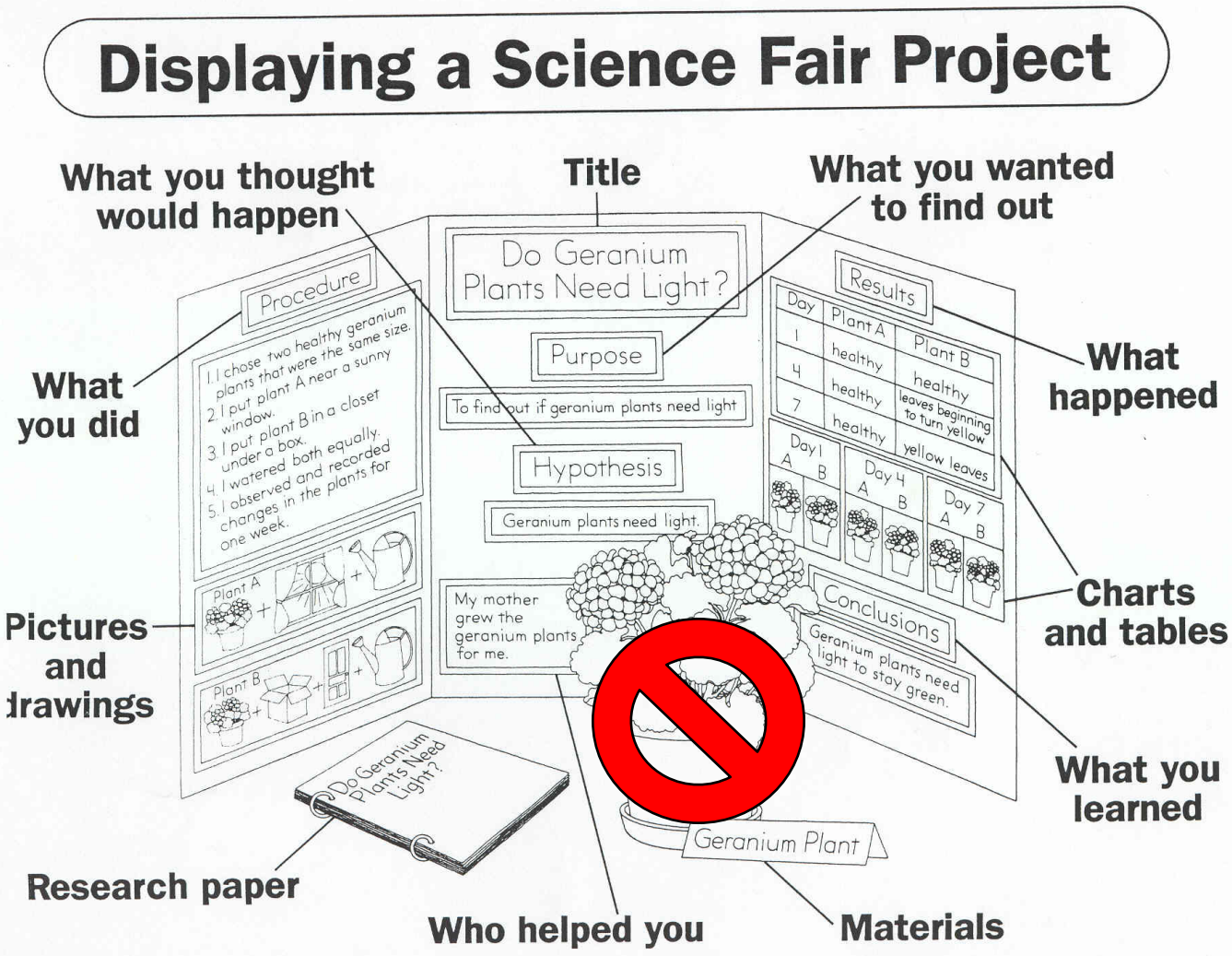
- Compose a research report/paper of your investigation (*OPTIONAL*)
- Research reports are not the same as research plan!

  - Research plan – prior approval, no data

  - Research paper – after experimentation, data and results

- Create a Display Board
- Compete at a local, school, county or district Science Fair


Display Layout
30" or 76 cm
36"
Question
Write question here
Prediction
Write prediction here
Experimental Design
Write five components of experimental design here
Project Title
Procedure
Write steps for procedure here
Results
Data Table
Graph
Provide data table(s) of results here
Provide graph(s) of results here
Maximum Size of Project Display
Depth (front to back): 30 inches or 76 centimeters
Width (side to side): 48 inches or 122 centimeters
Height (floor to top): 108 inches or 274 centimeters
Discussion
Write about trends in your results here
Conclusion
Write conclusion here
Literature Cited
List references here
108" or 274 cm
48" or 122 cm



Examples of a science project and an engineering project set up for your viewing

Fair Products

- **Abstract** – typed on 22-category form and must be displayed
- Science & Engineering Fair **display board**
- Lab data **notebook or research journal**
- **3-ring Binder** with
  - *Research paper (optional)*
  - *Original forms (including research plan)*
- **Photo and graph credits** - visible on display board (informed consent forms for any photographs of people other than exhibitor must be available)

FORMS

CHECKLIST FOR ADULT SPONSOR

FORM 1 – REQUIRED for all projects

FORM 1

To be completed by the Adult Sponsor in collaboration with the student researcher(s):

Student's Name(s):

Project Title:

1. ☐ I have reviewed the Georgia College K-5 State Science Fair Rules and Guidelines.

2. ☐ I have worked with the student to complete the Student Checklist (1A) and Research Plan/Project Summary.

3. ☐ I have worked with the student and parent/guardian and we have discussed the possible risks involved in the project.

4. Click The project involves one or more of the following and requires prior approval by an SRC or IRB (If yes, check all that apply to the project):

☐ Humans ☐ Vertebrate Animals ☐ Microorganisms ☐ rDNA ☐ Tissues

5. ☐ Items to be completed for **ALL PROJECTS**

- ☐ Adult Sponsor Checklist (1)
- ☐ Student Checklist (2)
- ☐ Research Plan/Project Summary
- ☐ Approval Form (3)
- ☐ Risk Assessment Form (4) – *Recommended for all projects but REQUIRED if YES for question 4

Adult Sponsor's Printed Name Date of Review

Adult Sponsor's Signature _____

Phone Email

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CHECKLIST FOR STUDENTS

FORM 2 – REQUIRED for all projects

To be completed by the Parent and/or Adult Sponsor in collaboration with the student researcher(s):

1. Student/Team Leader Name: Grade:

   Student (Parent/Guardian) Email: Phone:

2. Team Member Name (s): (if applicable)

3. School Name: School County:

   School Address: School Phone:

   School Administrator Name: School Administrator Email:

4. Adult Sponsor Name: Adult Sponsor Email/Phone:

5. Project Title:

6. ☐ I agree to follow the Georgia College K-5 State Science Fair Rules and Guidelines.

7. This year's laboratory experiment/data collection:

   Actual Start Date: (mm/dd/yy) End Date: (mm/dd/yy)

8. Where will you conduct your experimentation? (check all that apply)
   ☐ Research Institution ☐ School ☐ Field ☐ Home ☐ Other

9. **Working with the Parent and Adult Sponsor, the student should complete a Research Plan/Project Summary BEFORE experimentation.** *The purpose of a research plan is to serve as a proposal of what to expect and what needs to be done.* The Research Plan/Project Summary should include the following and be appropriate for grade level:
   a. **RATIONALE:** Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research.
   b. **RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED OUTCOMES:** How is this based on the rationale described above?
   c. Describe the following:
      i. **Procedures:** Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others.
      ii. **Risk and Safety: Identify any potential risks and safety precautions needed.**
      iii. **Data Analysis: Describe the procedures you will use to analyze the data/results.**
   d. **BIBLIOGRAPHY:** List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

10. **An abstract is required for all projects AFTER experimentation.**

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FORM 2

APPROVAL FORM FOR STUDENTS

FORM 3 – REQUIRED for EACH STUDENT including ALL team members

To be completed by the Parent, Adult Sponsor, and local/school science fair director in collaboration with the student researcher(s):

1. **To Be Completed by Student and Parent:**
   a. **Student Acknowledgment:**
      - I understand the risks and possible dangers to me of the proposed research plan.
      - I understand the Georgia College K-5 State Science Fair Rules and Guidelines and will adhere to all rules when conducting this research.
      - I understand and will abide by the following Ethics statement

Scientific fraud and misconduct are not condoned at any level of research or competition. Such practices include but are not limited to plagiarism, forgery, use or presentation of other researcher's work as one's own, and fabrication of data. Fraudulent projects will fail to qualify for competition in affiliated fairs.

Student's Printed Name **Signature** _____
Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

   b. **Parent/Guardian Approval:**
      - I have read and understand the risks and possible dangers involved in the Research Plan/Project Summary.
      - I have read and understand the Georgia College waiver of liability, Photo and Media Release, Code of Conduct, and Participation Forms.
      - **I consent to my child participating in this research and competing at the Georgia College K-5 State Science Fair.**

Parent/Guardian's Printed Name **Signature** _____
Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

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2. **To Be Completed by Adult Sponsor and local/school science fair director:**
   ***Required ONLY for projects that need prior SRC/IRB approval BEFORE experimentation** (humans, vertebrates or potentially hazardous biological agents).

   The SRC/IRB of the local/school science fair has carefully studied this project's **Research Plan/ Project Summary** and all the required forms are included. My signature indicates approval of the **Research Plan/Project Summary** ***BEFORE the student begins experimentation***.

Adult Sponsor Printed Name **Signature** _____
Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

Local Science Fair Director Printed Name **Signature** _____
Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

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FORM 3

RISK ASSESSMENT

FORM 4– REQUIRED for projects using hazardous chemicals, activities or devices, and microorganisms.
*Recommended for all projects. Must be completed BEFORE experimentation.

FORM 4

To be completed by the Parent and/or Adult Sponsor in collaboration with the student researcher(s):

Student's Name(s):

Project Title:

1. List all hazardous chemicals, activities, or devices that will be used; identify microorganisms.

2. Identify and assess the risks involved in this project.

3. Describe the safety precautions and procedures that will be used to reduce the risks.

4. Describe the disposal procedures that will be used (when applicable).

5. List the source(s) of safety information.

I agree with the risk assessment and safety precautions and procedures described above. I certify that I have reviewed the Research Plan/Project Summary and will provide direct supervision.

Adult Sponsor Printed Name **Signature** _____
Date Acknowledged (mm/dd/yy) (Must be prior to experimentation.)

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ABSTRACT FORM – 2 PAGES

K-5 OFFICAL ABSTRACT FORM

ABSTRACT FORM – REQUIRED for ALL projects. To be completed AFTER experimentation.

To be completed by the Parent and/or Adult Sponsor in collaboration with the student researcher(s):

PROJECT TITLE

STUDENT NAME(S) GRADE

SCHOOL NAME SCHOOL COUNTY

Type ABSTRACT below using 10-point font.

Category: Pick one only— mark an "X" in box at right

- ☐ Animal Sciences
- ☐ Behavioral and Social Science
- ☐ Biochemistry
- ☐ Biomedical and Health Sciences
- ☐ Cellular and Molecular Biology
- ☐ Chemistry
- ☐ Computational Biology and Bioinformatics
- ☐ Earth and Environmental Sciences
- ☐ Embedded Systems
- ☐ Energy: Chemical
- ☐ Energy: Physical
- ☐ Engineering Mechanics
- ☐ Environmental Engineering
- ☐ Materials Science
- ☐ Mathematics
- ☐ Microbiology
- ☐ Physics and Astronomy
- ☐ Plant Sciences
- ☐ Robotics
- ☐ Systems Software

ANSWER THE FOLLOWING QUESTIONS:

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):
   ☐ Humans ☐ Vertebrate Animals ☐ Microorganisms ☐ rDNA ☐ Tissues
2. I/we worked or used equipment in a regulated research institution or industrial setting: ☐YES ☐NO
3. This project is a continuation of previous research. ☐YES ☐NO
4. My display board includes non-published photographs/visual depictions of humans (other than myself): : ☐YES ☐NO
5. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only : ☐YES ☐NO
6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work. : ☐YES ☐NO

This stamp or embossed seal attests that this project is in compliance with all state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Georgia college K-5 State Science Fair Scientific Review Committee.

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